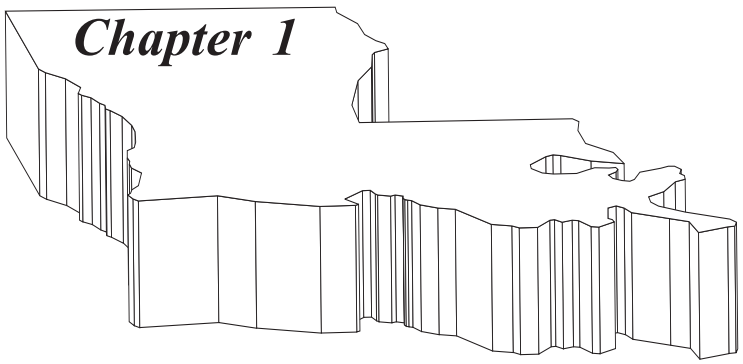


Step-by-Step Energy Efficient Construction

Chapter 1 is a quick reference guide that shows the key elements of energy efficient construction. The energy features save money, improve indoor air quality, enhance comfort, prevent moisture problems, and increase the long term durability of the building. The features shown in the following pages are described in detail in the other chapters.

To ensure a successful home, follow the concepts introduced in Chapter 3. The features must be included in the plans and specifications for the home and described thoroughly to the subcontractor responsible for their installation. Too often, an excellent plan falls short of expectations because of inadequate attention to the details.

The positive economic return is an important benefit of the measures shown in this series of chapters. The energy savings exceed the additional annual mortgage costs of the measures. Thus, the payback period, even when considering the additional payment for the measures, is typically within one or two years.

Table 1-1 is from Chapter 2 on energy packages. The 5-Star Home package is a set of energy measures that exceeds the Model Energy Code and provides an excellent return on investment. Five-Star Energy Plus goes well beyond the Model Energy Code, but still provides an excellent return. The Five-Star Home Energy Rating may allow for preferential focus from financial institutions. Contact the Louisiana Department of Natural Resources for information on Home Energy Ratings. (800-836-9589 in Louisiana, or 342-1399 in Baton Rouge) [on-line at www.dnr.state.la.us/energy].

Table 1-1
Economic Analysis of Energy Efficient Packages*

	Annual Energy Costs ($)			
	Code Home	Five-Star Home	Five-Star Plus	Passive Solar Home**
Heating	444	224	113	135
Cooling	563	290	183	320
Hot Water	396	366	171	220
Lighting	84	56	42	56
Other (Appliances; Service Charges)	356	321	289	321
Total	**1,843**	**1,258**	**798**	**1,052**
Annual Energy Savings		**585[1]**	**1,045[1]**	**791[1]**
Typical Additional Construction Costs		**2,466[1]**	**5,635[1]**	**5,466[1]**
Extra Mortgage ($/yr) (8% loan for 30 years)		**217[1]**	**496[1]**	**481[1]**
Payback Period (years)		**4.2**	**5.4**	**6.9**
Estimated Rate of Return (IRR)		**53%[1]**	**42%[1]**	**29%[1]**

* For a two-story, 2,000 square-foot home in Baton Rouge
** Includes extra cost of 5-Star Home features, additional south-facing glass, and thermal mass
[1] Compared to Code Home

ENERGY EFFICIENT HOMES: THE KEY FEATURES

Moisture barrier system — drain water away from foundation; install capillary breaks and 6-mil polyethylene ground cover; make interior finish airtight; follow careful flashing details for roof, around windows and doors, and other roof and wall penetrations through which wind-driven rain may leak

Air barrier system — eliminate leakage between conditioned and unconditioned spaces, in particular between living areas and crawlspaces, unheated basements, attics, and garages.

Continuous insulation system — install insulation as continuously as possible between conditioned and unconditioned spaces.

- ❒ Exterior walls, floors over unconditioned or exterior spaces, ceilings below unconditioned or exterior spaces (including attic access covers).
- ❒ Wall areas adjacent to attic spaces or basement spaces — such as knee walls, attic stairways, and high interior walls with attic or exterior space behind.
- ❒ Wall areas between conditioned and unconditioned spaces — such as band joists, garage walls, basement stairways, and mechanical room walls.

Select and install energy efficient windows

- ❒ Design home with minimal east and west glass area, locate additional glass area on south side for passive heating in winter months, consider passive solar designs to further reduce heating needs.
- ❒ Use double-glazed windows with U-values under 0.65 (R-values of at least 1.54).
- ❒ Consider low-emissivity coatings and other high performance features.
- ❒ Shade windows in summertime with overhangs or glazing treatments.

Design heating and cooling system for efficiency

- ❒ Size and properly install high efficiency equipment designed for local climate.
- ❒ Eliminate potential for backdrafting of combustion appliances.
- ❒ Install fresh air ventilation systems to bring in outside air when needed.

Seal ductwork

- ❒ Locate ductwork in conditioned spaces.
- ❒ Size and lay out ductwork to supply proper airflow; measure airflow to guarantee comfort.
- ❒ Seal all duct leaks, except those in removable components, with mastic or mastic plus fiber mesh; seal leaks around removable components with UL-181 A or B foil-backed duct tape.

Minimize hot water costs

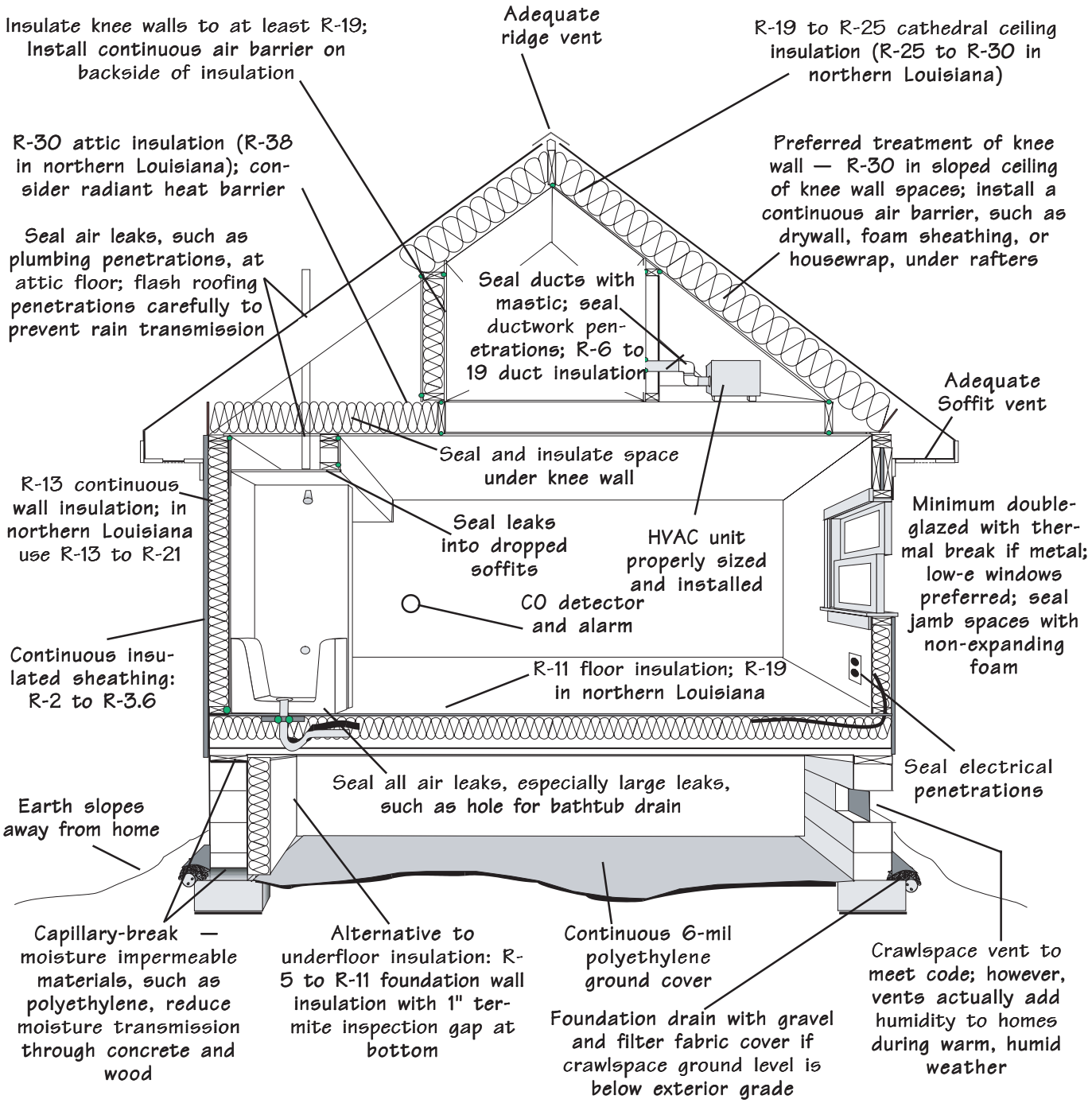
- ❒ Select efficient equipment, use heat traps to prevent convective loops, install water heater wraps.
- ❒ Use water-conserving fixtures and appliances.

Choose energy efficient appliances and lighting

- ❒ Install fluorescent or compact fluorescent fixtures, if on over 4 hours per day.
- ❒ Use recessed lights selectively and choose only airtight, IC (insulation contact)-rated lamps.
- ❒ Choose high-pressure sodium or metal halide lamps for exterior lighting with daylight sensors if used for security lighting.

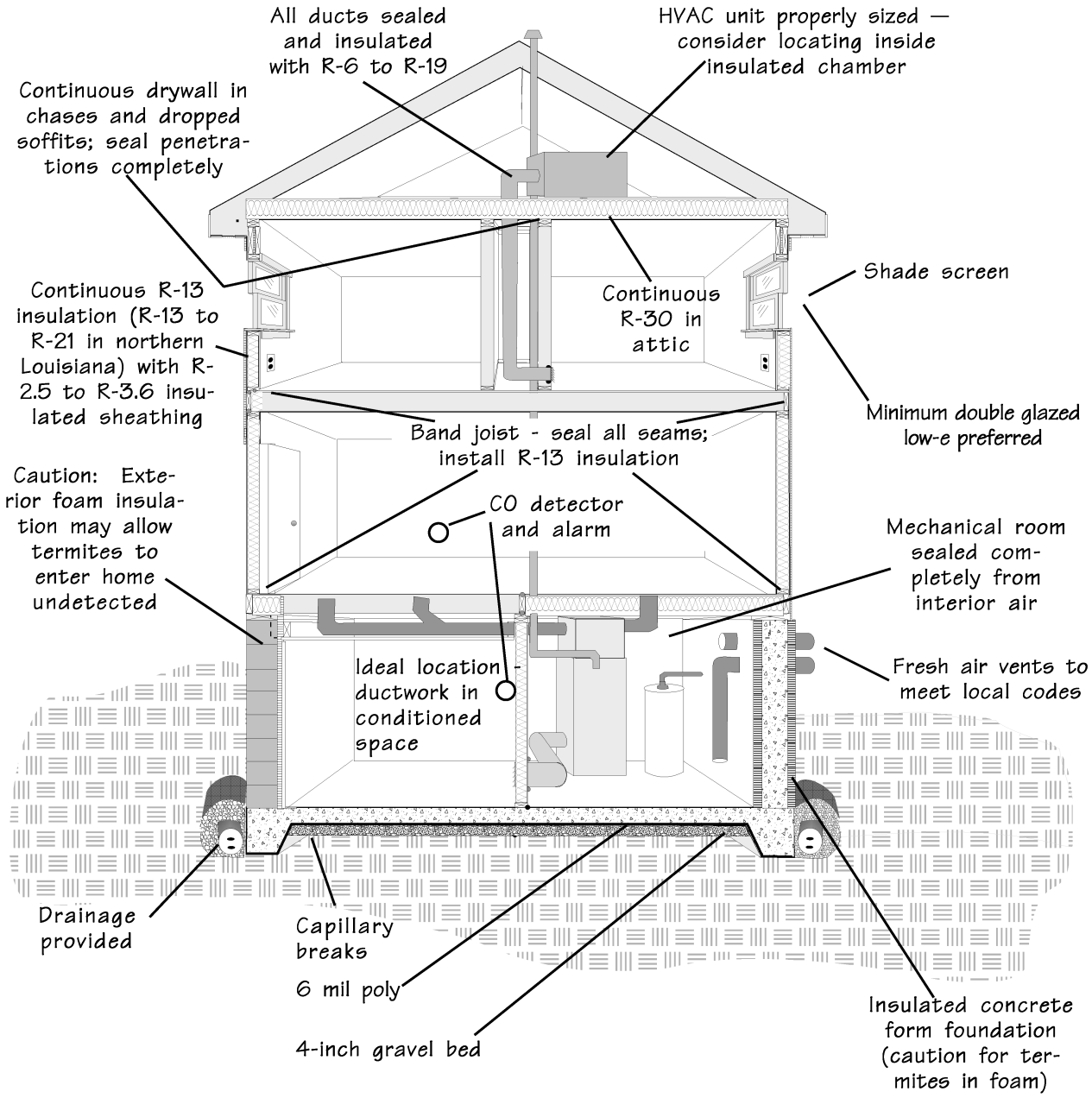
SAMPLE BUILDING SECTIONS - CRAWLSPACE HOME

Figure 1-1
Sample Building Sections - Crawlspace Home



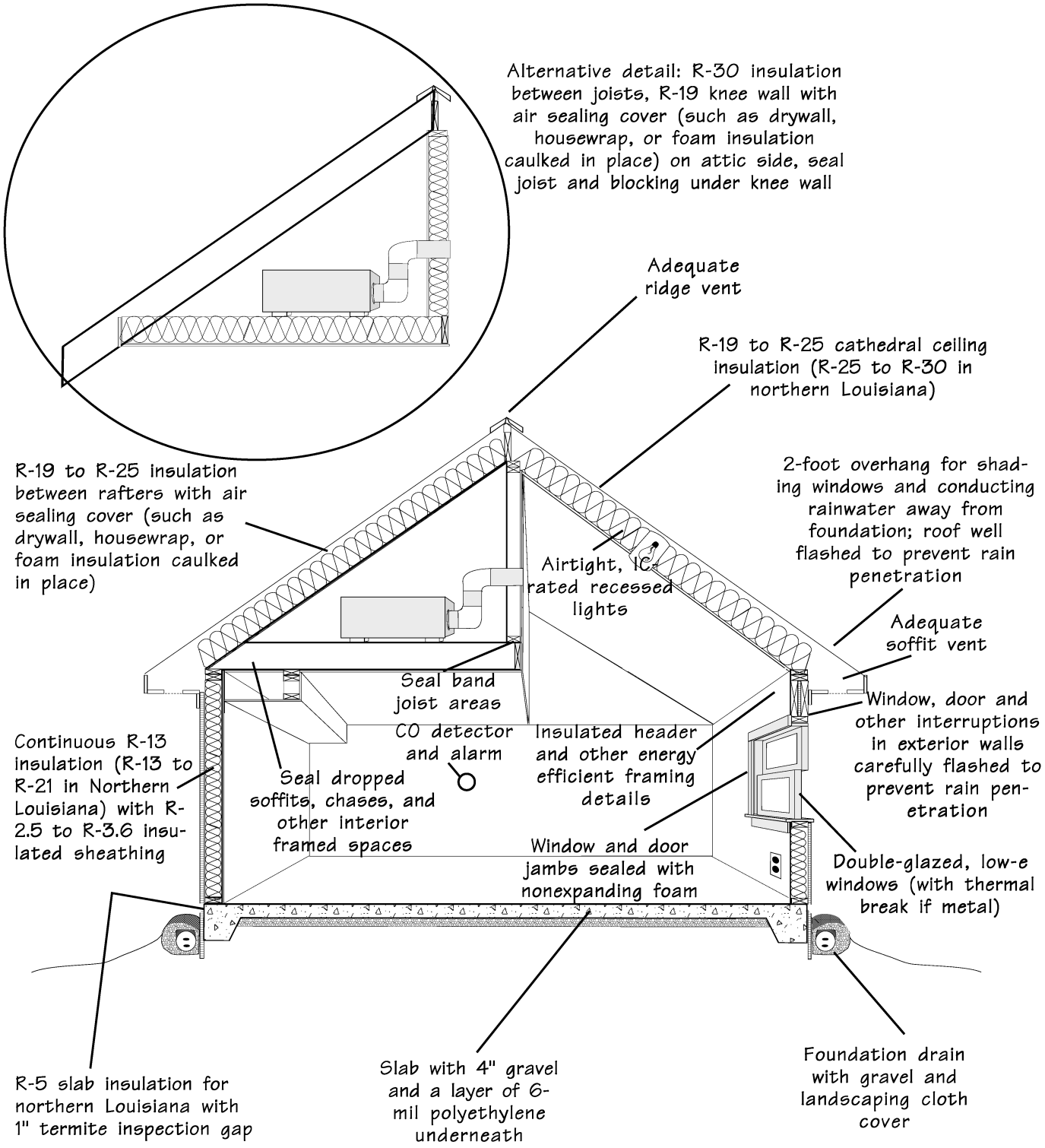
SAMPLE BUILDING SECTIONS - TWO-STORY WITH CONDITIONED BASEMENT

Figure 1-2
Sample Building Sections - Two-Story with Conditioned Basement



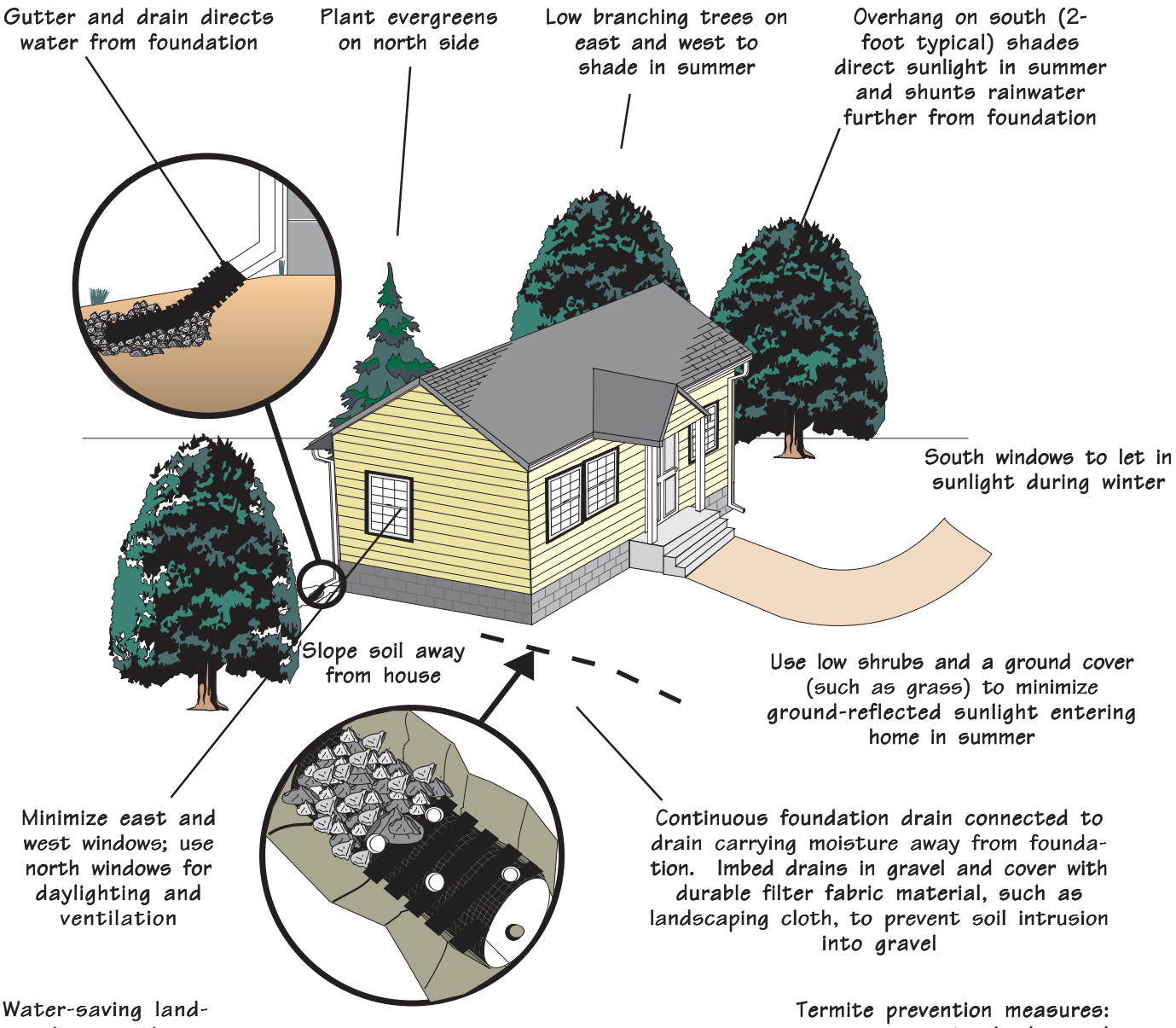
SAMPLE BUILDING SECTIONS - SLAB-ON-GRADE

Figure 1-3
Sample Building Sections - Slab-On-Grade



1. Site Planning

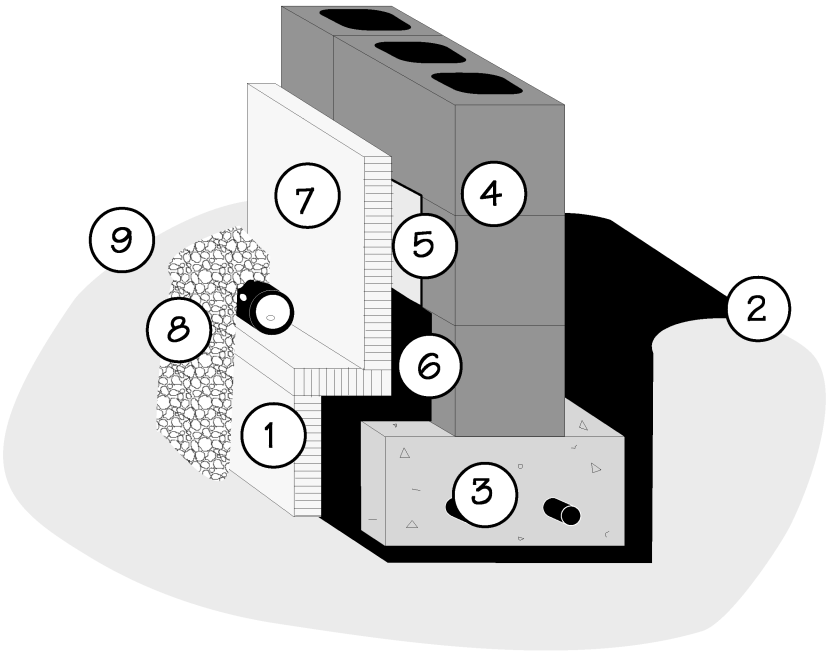
Figure 1-4
Site Planning



2. Footing and Foundation Wall

1. If required or specified, insulate footing and foundation wall — make footing trench wide enough for foam insulation board. Meet with pest control company to discuss viability of termite contract with insulated foundation wall.
2. Install layer of 6-mil polyethylene as a capillary break; the earth inside crawlspace should be higher than outside grade.
3. Set rebar as required and pour concrete.
4. Build foundation wall.
5. Waterproof below-grade portion of foundation wall.
6. Wrap plastic against foundation wall.
7. If conditioned basement or habitable rooms are located behind foundation wall, insulate exterior with 1-2 inches of foam insulation or insulate interior of wall.
8. Cover perforated drain pipe with gravel; install filter fabric over drainage pipe and gravel.
9. When backfilling foundation wall, slope earth away from house 5% (1' vertical for every 20' horizontal). Consider using a high density fiberglass drainage board over or in place of insulation.

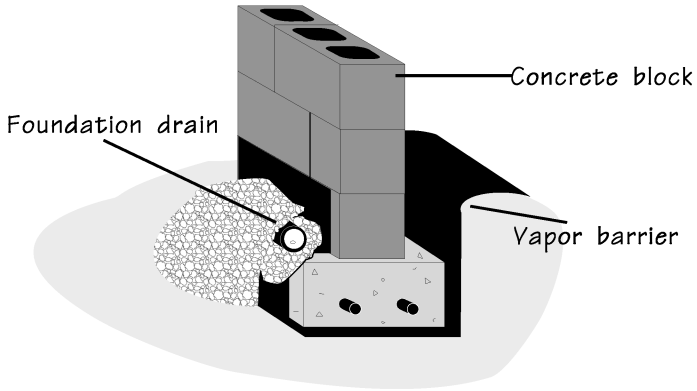
Figure 1-5
Footing and Foundation Wall



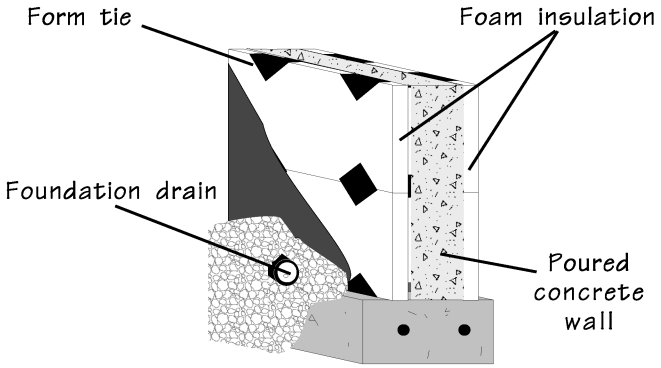
FOUNDATION ALTERNATIVES

Figure 1-6
Foundation Alternatives

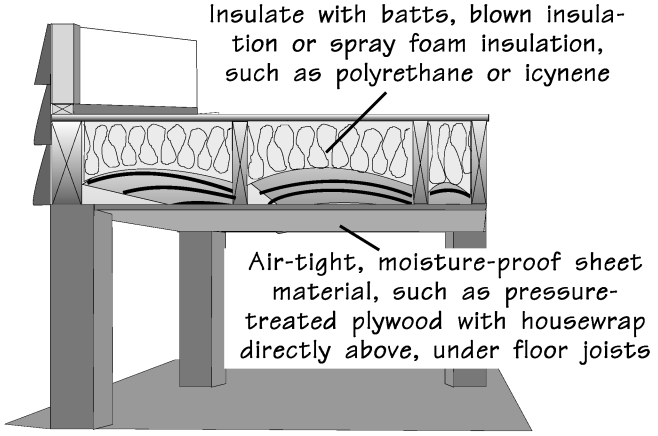
A) For uninsulated crawlspace walls — skip foam insulation and waterproofing. The earth inside the crawlspace should be higher than outside grade. If not, install a drainage system.



B) Insulated concrete form (ICF) foundations — check with manufacturer carefully for cost effectiveness, recommended waterproofing, type of termite treatments, concrete specifications, reinforcing requirements, and other stipulations.



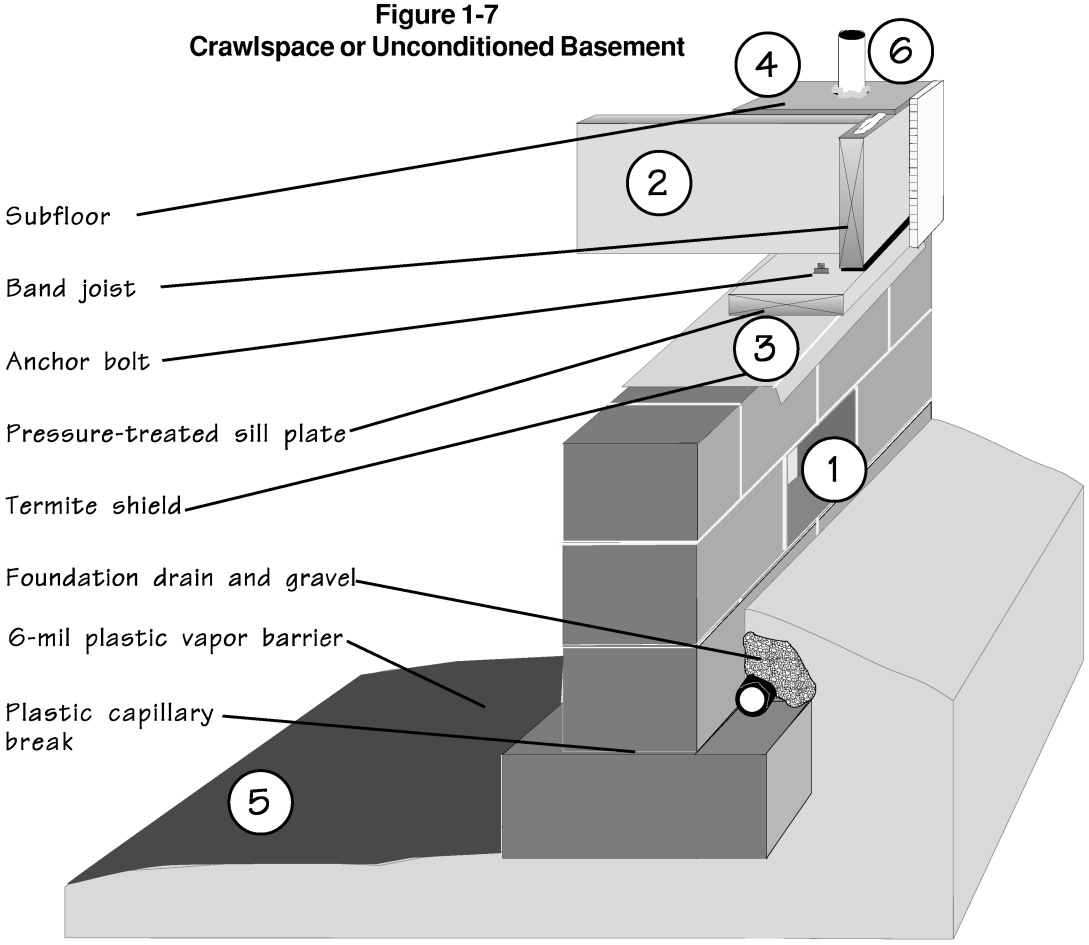
C) Pier foundations — insulation under the floor of pier foundations can deteriorate over time due to air leakage, moisture, and pests. For high performance homes, insulate under the floor with complete coverage and install a complete air barrier under the floor joists. Seal all penetrations through the air barrier, and caulk all seams and joints.



3. Crawlspace or Unconditioned Basement

1. Install operable foundation vents, as required by local codes, in crawlspace walls (check for changes in codes, as the requirement for foundation vents is being reevaluated in certain areas).
2. Consider "engineered" joists - wood I-joists or floor trusses — in place of dimensional lumber such as 2x10s or 2x12s.
3. Set band joists and floor joists on top of capillary break, such as termite shield, sill sealer material, or polyethylene.
4. Glue subfloor to band joists and framing around openings, as in the case of basement stairs.
5. Lay plastic vapor barrier on crawlspace floor.
6. Seal all holes through floor as home is constructed.

Figure 1-7
Crawlspace or Unconditioned Basement

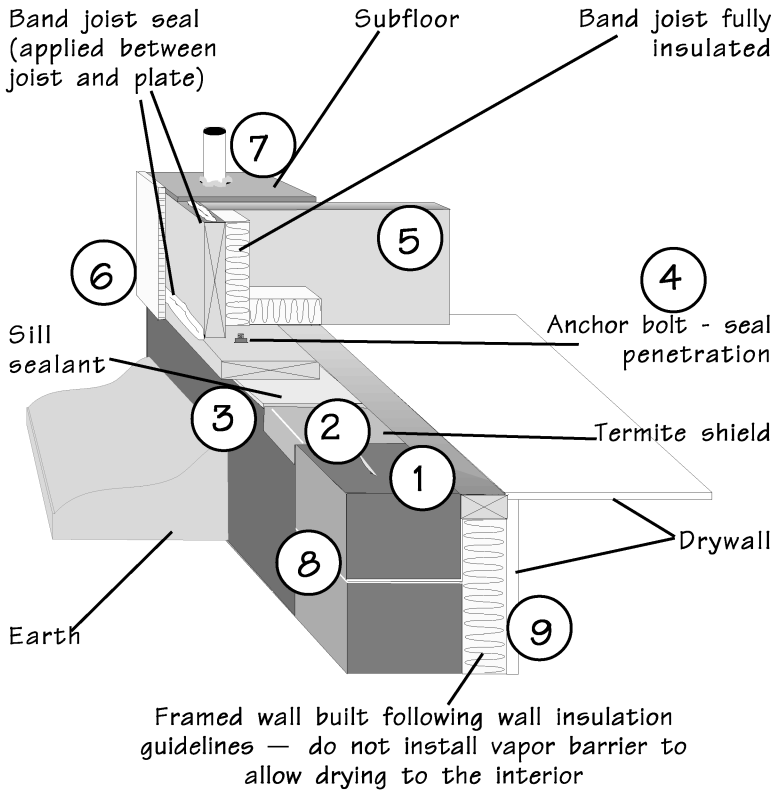


4. Floor — Conditioned Basement

See details for crawlspace floors; after foundation wall is built:

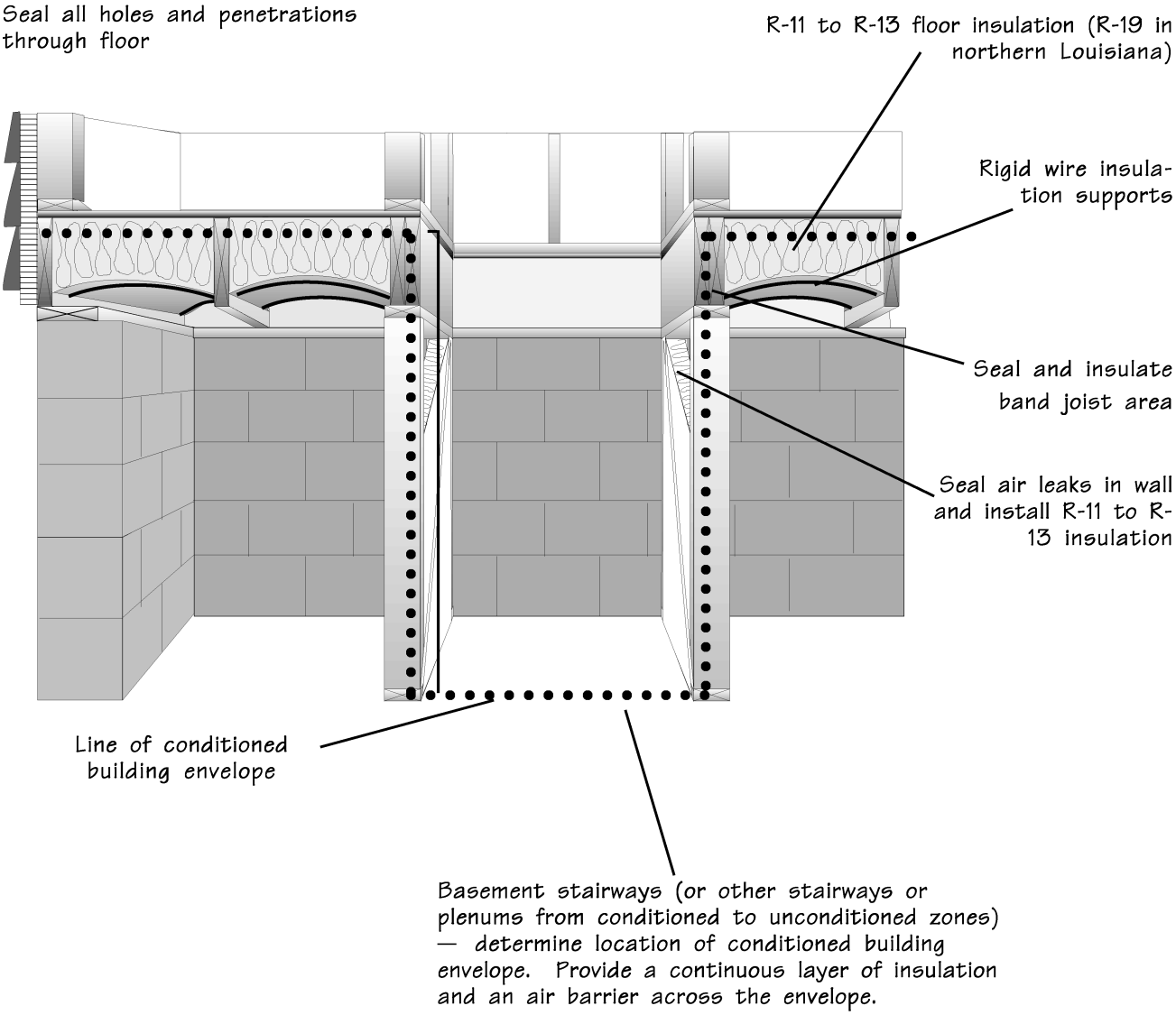
1. Caulk under termite shield.
2. Install termite shield, seal all joints and holes for anchor bolts.
3. Place sill sealant material.
4. Predrill pressure-treated sill plate — bolt in place.
5. Set joists.
6. Seal seam between band joist and sill plate with durable caulking — either between joists and plates or from outside after floor framing is completed.
7. Caulk subfloor to band joist.
8. Waterproof wall.
9. Install interior framed, insulated wall.

Figure 1-8
Interior Framed, Insulated Wall



5. Insulated Floor

Figure 1-9
Insulated Floor



6. Wall Framing

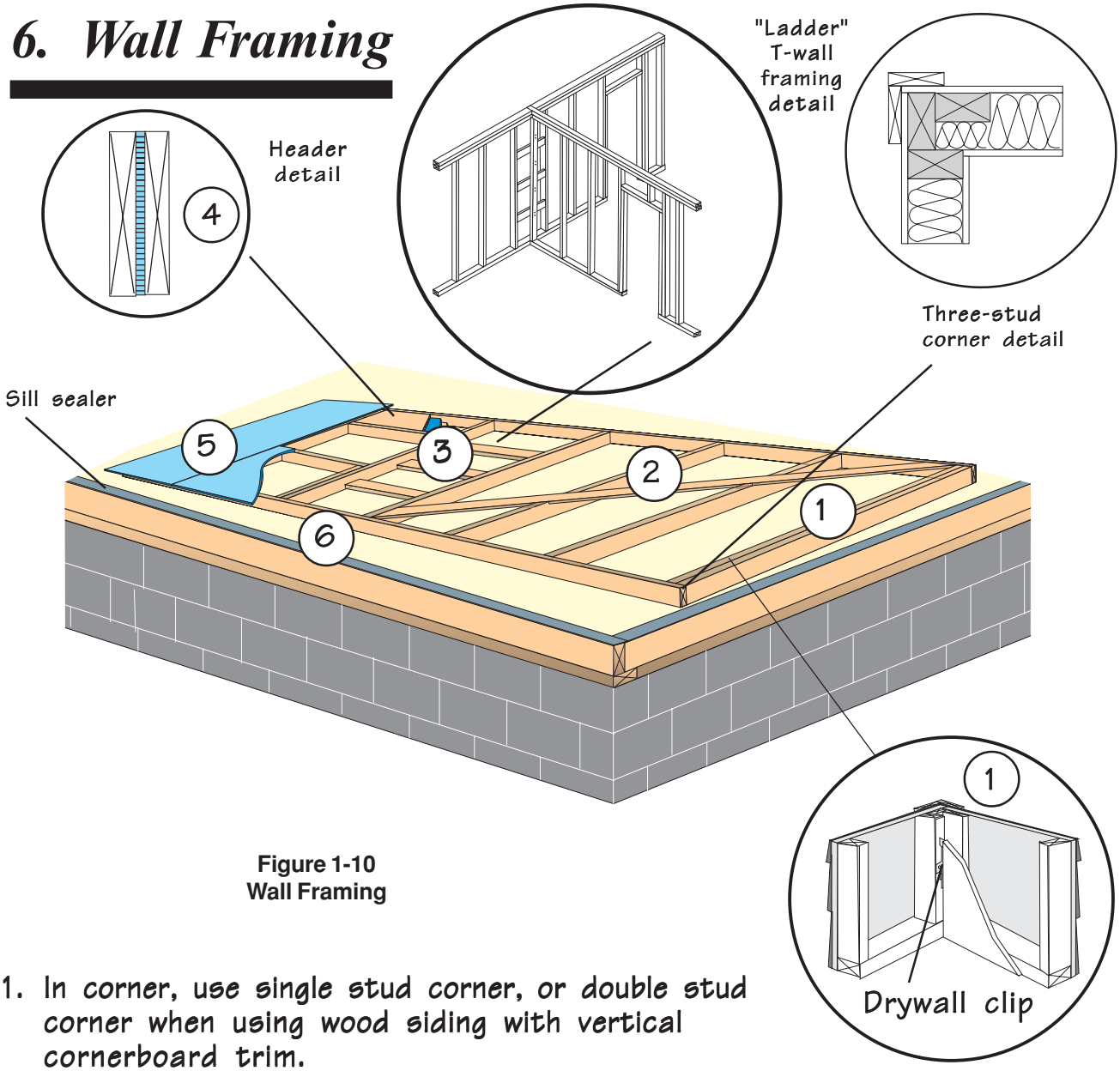


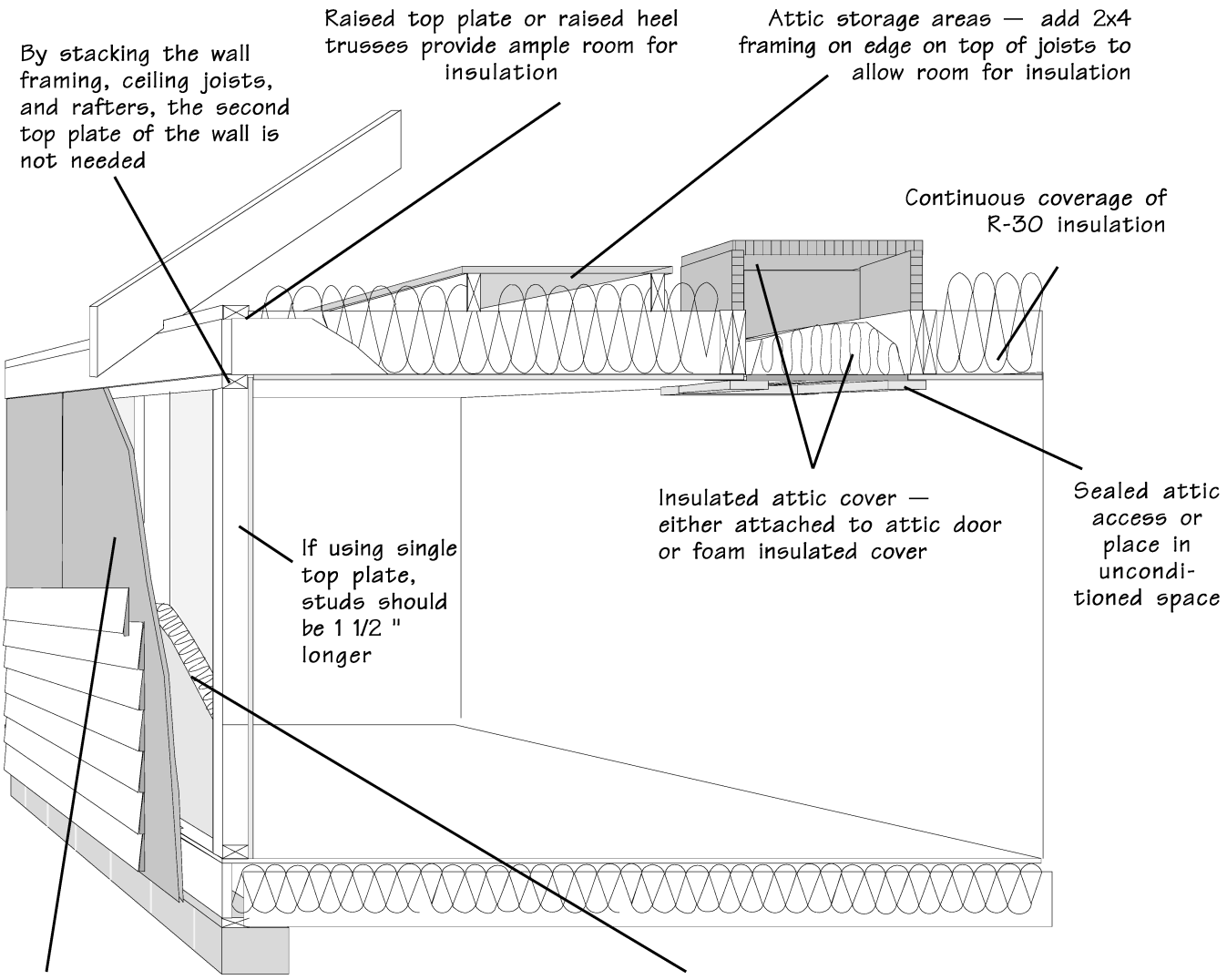
Figure 1-10
Wall Framing

Corner framing detail with vertical corner board and wood siding

1. In corner, use single stud corner, or double stud corner when using wood siding with vertical cornerboard trim.
2. Use metal T-brace or 1 x 4 let-in bracing for corners.
3. At partition wall (T-wall) intersection, eliminate additional studs for nailing drywall; use "ladder" instead.
4. Add 1/2" foam to structural headers.
5. Cover wall with 1/2" foam sheathing, including band joists and second top plates.
6. Before lifting wall in place, attach sill sealant material to subfloor or apply a double bead of caulking.

7. Wall and Ceiling Detailing

Figure 1-11
Wall and Ceiling Detailing

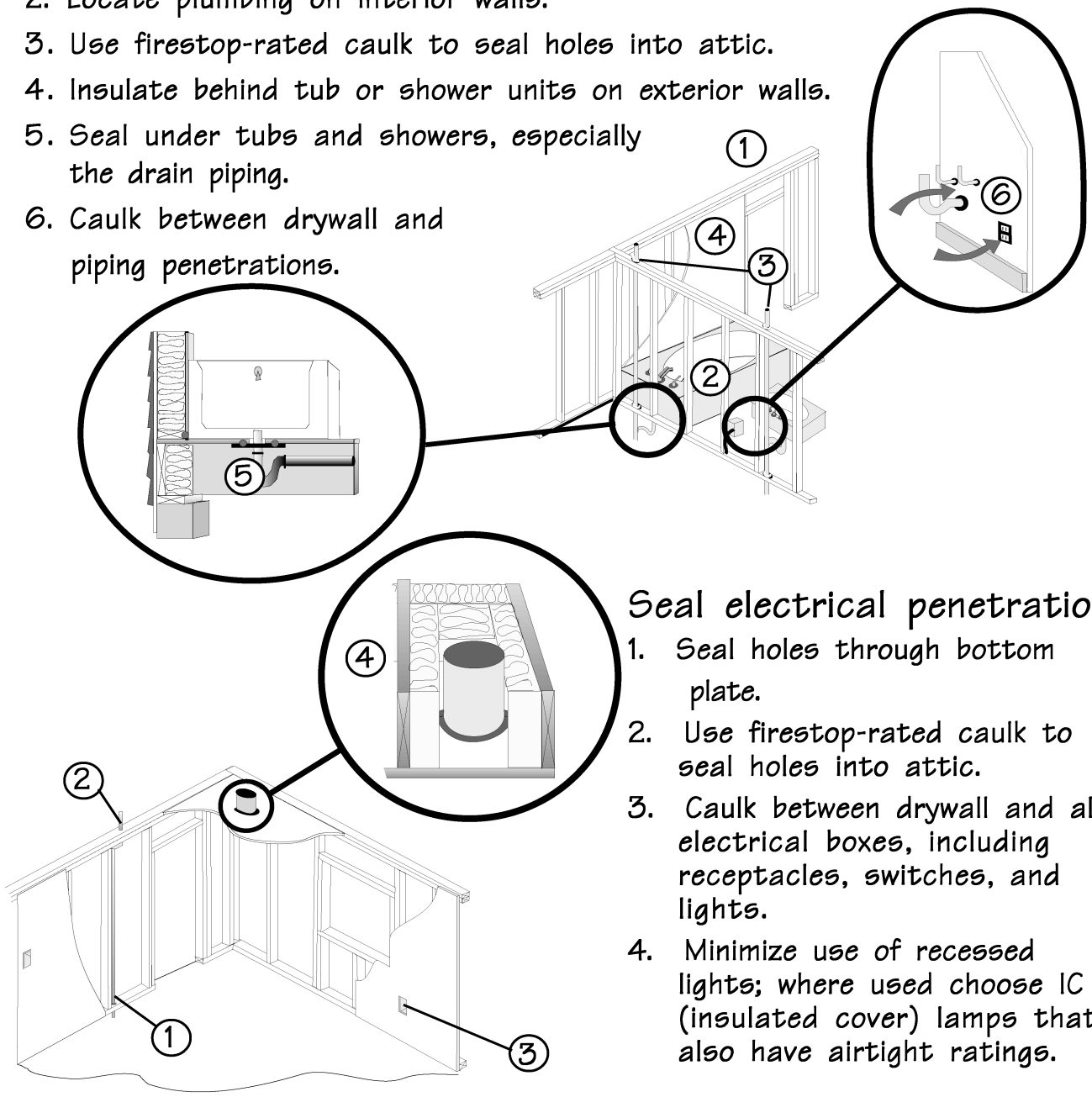


8. Seal Holes and Penetrations

Figure 1-12
Sealing Holes and Penetrations

Seal plumbing penetrations

1. Cover all chases and framing open to attic with drywall or other fire-resistant sheet good. Seal all holes and cracks in cover.
2. Locate plumbing on interior walls.
3. Use firestop-rated caulk to seal holes into attic.
4. Insulate behind tub or shower units on exterior walls.
5. Seal under tubs and showers, especially the drain piping.
6. Caulk between drywall and piping penetrations.

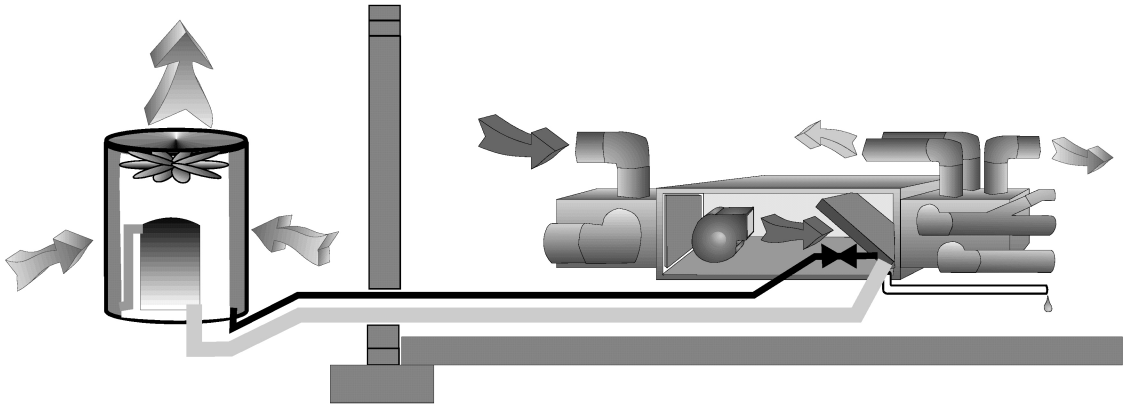


Seal electrical penetrations

1. Seal holes through bottom plate.
2. Use firestop-rated caulk to seal holes into attic.
3. Caulk between drywall and all electrical boxes, including receptacles, switches, and lights.
4. Minimize use of recessed lights; where used choose IC (insulated cover) lamps that also have airtight ratings.

9. HVAC Systems

Figure 1-13
HVAC Systems

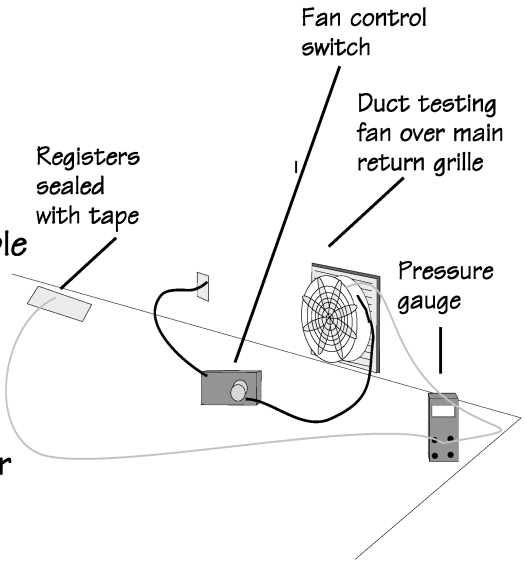


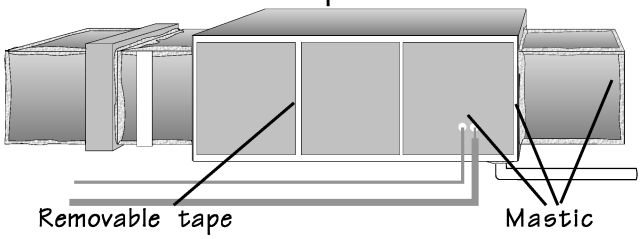
1. Size for heating and cooling load using Manual J techniques.
2. Size latent (dehumidification) load for cooling system.
3. Compare cost and projected energy savings of at least 3 HVAC contractor bids and 3 equipment options:
   a. Minimum efficiency: SEER 10-12 cooling, AFUE 0.78-0.80 furnace, HSPF 6.8-7.2 heat pump
      (new code changes may disallow this lower efficiency equipment)
   b. Moderate efficiency: SEER 12-13 cooling, AFUE .80-.84 furnace, HSPF 7.2-7.6 heat pump
   c. High efficiency: SEER 13-15 cooling, AFUE .90+ furnace, HSPF 7.6-8.2 heat pump
4. Consider a single, automatically controlled zoned system instead of two or more separate systems.
5. When selecting a contractor, don't just go by price:
   a. reputation for quality
   b. type of duct system
   c. number of returns
   d. sound muffling components
   e. willingness to ensure and test for pressure imbalances, proper airflow, and airtight ductwork

10. Ductwork

1. Design ducts using Manual D methods; locate as much ductwork as possible in conditioned spaces sealed from outside.
2. Install returns in each room with a closeable door and more than one supply.
3. Undercut doors in rooms with a single supply by a clear 3/4" to 1" above flooring/carpet.
4. Seal ducts with mastic or mastic and fiber mesh — use guidelines in Chapter 8.
5. Test ducts for air tightness.
6. Test home for pressure imbalance problems.

Figure 1-14
Duct Testing Fan Setup





Many air handler cabinets come from the factory with leaks. Use mastic to seal holes and seams. Seal removable panels with cloth or metal duct tape.

Figure 1-15
Prevent Pressure Imbalances

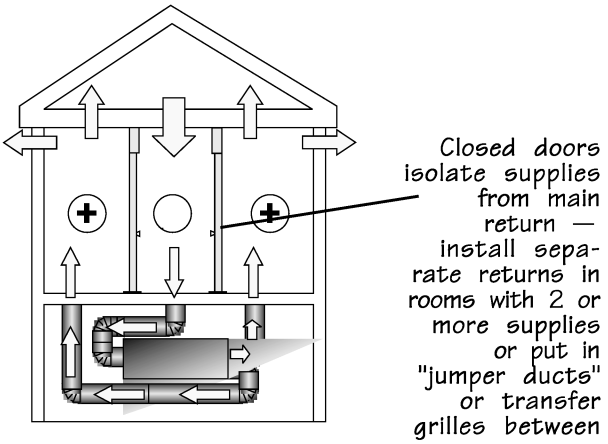
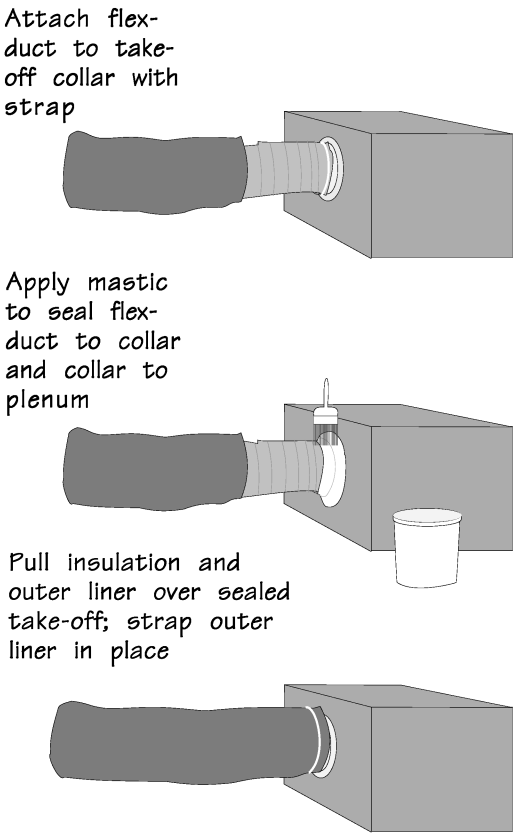


Figure 1-16
Sealing Flex Duct Takeoffs



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